Scientific & Technical Information Center

Search Report

EIC 1700

STIC Database Tracking Number: 231637

To: WAYNE LANGEL
Location: REM-9A29
Art Unit: 1754
Wednesday, July 25, 2007
Phone: (571) 272-1353
Case Serial Number: 10 / 518644

From: JAN DELAVAL
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Search Notes

SCI. TECH INF. CTR

JUL 20 RECD

Pat. & T.M Office

SEARCH REQUEST FORM

Scientific and Technical Information Center

Requester's Full Name: Wayne Langel Examiner # : 60603 Date: 7-20-07
Art Unit: 1754 Phone Number 2-1353 Serial Number: 10/518644
Mail Box and Bldg/Room Location: E09A29 (Remsen) Results Format Preferred (circle): PAPER DISK E-MAIL

If more than one search is submitted, please prioritize searches in order of need.

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Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc. if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Sp3 bond boron nitride emitting light in ultraviolet region, its producing method, and functional material using same

Inventors (please provide full names): Shojiro Komatsu, Katsuyuki Okada, Yusuke Moriyoshi

Earliest Priority Filing Date: 7-2-02

***For Sequence Searches Only* Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.**

Please search claims 1-12, as attached hereto.

****

STAFF USE ONLY	**Type of Search**	**Vendors and cost where applicable**
Searcher: Jan	NA Sequence (#)	STN ✓
Searcher Phone #:	AA Sequence (#)	Dialog
Searcher Location:	Structure (#)	Questel/Orbit
Date Searcher Picked Up: 7/25/07	Bibliographic ✓	Dr.Link
Date Completed: 7/25/07	Litigation	Lexis/Nexis

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FILE LAST UPDATED: 24 Jul 2007 (20070724/ED)

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L109 ANSWER 1 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN 2004:41398 HCAPLUS
DN 140:101789
TI **Sp3** bonded **boron nitride emitting UV light**, its production method, and functional material
IN **Komatsu, Shojiro; Okada, Katsuyuki; Moriyoshi, Yusuke**
PA **National Institute for Materials Science, Japan**
SO PCT Int. Appl., 30 pp.
CODEN: PIXXD2
DT **Patent**
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE	
PI	WO 2004005186	A1	20040115	WO 2003-JP8370	20030701	<--
	W: US					
	RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR					
	JP 2004035301	A	20040205	JP 2002-192863	20020702	<--
	JP 3598381	B2	20041208			
	EP 1518824	A1	20050330	EP 2003-738617	20030701	<--
	R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, FI, RO, CY, TR, BG, CZ, EE, HU, SK					
	US 2006163527	A1	20060727	US 2004-518644	20041220	<--
PRAI	JP 2002-192863	A	20020702 <--			
	WO 2003-JP8370	W	20030701 <--			

AB The invention refers to a **B nitride** suitable for use as an electronic material for electroluminescent devices, **UV** solid state lasers, and coating material, having **hexagonal 5H** or **6H** polygonal structure which **emits UV light**, produced by mixing B-containing and N-containing **gases** and a diluent **gas** in a reactor,

irradiating a substrate inside the reactor with **UV light** to deposit the **B nitride** on the substrate.

IC ICM C01B0021-064
ICS C23C0014-06; C23C0016-38

CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 49

ST **boron nitride UV** radiation laser electroluminescent device

IT **Electroluminescent devices**
Solid state lasers
UV lasers
(**Sp3** bonded **boron nitride emitting UV light,** its production method, and functional material)

IT **10043-11-5P, Boron nitride,** uses
RL: DEV (Device component use); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)
(**Sp3** bonded **boron nitride emitting UV light,** its production method, and functional material)

IT 7664-41-7, **Ammonia,** reactions 19287-45-7, Diborane
RL: RCT (Reactant); RACT (Reactant or reagent)
(**Sp3** bonded **boron nitride emitting UV light,** its production method, and functional material)

IT **10043-11-5P, Boron nitride,** uses
RL: DEV (Device component use); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)
(**Sp3** bonded **boron nitride emitting UV light,** its production method, and functional material)

RN 10043-11-5 HCAPLUS

CN Boron nitride (BN) (CA INDEX NAME)

B≡N

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Director General Of Nat	1998			JP 10-7409 A	HCAPLUS
National Institute For	1994			JP 06-316402 A	HCAPLUS
National Institute For	1994			US 5286533 A	HCAPLUS
Semiconductor Energy La	1991			JP 03-79770 A	HCAPLUS
Sumitomo Electric Indus	1993			JP 05-4808 A	HCAPLUS

L109 ANSWER 2 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN

AN 2002:933559 HCAPLUS

DN 138:212175

TI Highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma** -packets-assisted pulsed-laser deposition: An **ultraviolet light emitter** at 225 nm

AU **Komatsu, Shojiro**; Kurashima, Keiji; Kanda, Hisao; **Okada, Katsuyuki**; Mitomo, Mamoru; **Moriyoshi, Yusuke**; Shimuzu, Yoshiki; Shiratani, Masaharu; Nakano, Toshiki; Samukawa, Seiji

CS **National Institute for Materials Science, 1-1 Namiki, ukuba, Ibaraki, 305-0044, Japan**
SO Applied Physics Letters (**2002**), 81(24), 4547-4549
CODEN: APPLAB; ISSN: 0003-6951
PB American Institute of Physics
DT Journal
LA English
AB Highly crystalline **5H-polytypic** form of **sp3** -bonded **boron nitride** (BN) was grown by pulsed-laser-vaporization of BN, where synchronous reactive-**plasma** packets assisted the crystal growth in the vapor phase. The structure of the product crystallites (.apprx.5 μm) was confirmed by using transmission electron diffraction and electron energy loss spectroscopy. This material proved to have a sharp and dominant band at 225 nm by cathodoluminescence at room temps. and corresponding monochromatic images revealed that they uniformly **emitted** the **UV light**. Considering that **cubic BN** has already been doped as p- and n-type semiconductors, this material may be applied to the **light-emitting** devices working at almost the deepest limit of the **UV** region that is functional without vacuum.
CC 73-5 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 75, 76
ST cryst **boron nitride plasma** packet laser deposition **UV** cathodoluminescence
IT Crystallites
(**UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)
IT **Cathodoluminescence**
(**UV**; of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)
IT Electron beams
(electron energy loss spectra; of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)
IT Vapor deposition process
(laser ablation; **UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)
IT Crystallinity
Electron diffraction
Surface structure
(of highly crystalline **5H-polytype** of **sp3** -bonded **boron nitride** prepared by **plasma** -packets-assisted pulsed-laser deposition)
IT **Plasma**
(reactive, packets; **UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)
IT **10043-11-5P, Boron nitride** (BN), properties
RL: PEP (Physical, engineering or chemical process); PNU (Preparation, unclassified); PRP (Properties); PYP (Physical process); PREP (Preparation); PROC (Process)

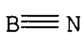
(**UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)

IT 7440-37-1, **Argon**, uses
RL: NUU (Other use, unclassified); USES (Uses)
(**argon-ammonia** reactive **plasma gas**; **UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)

IT 7664-41-7, **Ammonia**, uses
RL: NUU (Other use, unclassified); RCT (Reactant); RACT (Reactant or reagent); USES (Uses)
(**argon-ammonia** reactive **plasma gas**; **UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)

IT **10043-11-5P**, **Boron nitride** (BN), properties
RL: PEP (Physical, engineering or chemical process); PNU (Preparation, unclassified); PRP (Properties); PYP (Physical process); PREP (Preparation); PROC (Process)
(**UV** cathodoluminescence of highly crystalline **5H-polytype** of **sp3**-bonded **boron nitride** prepared by **plasma**-packets-assisted pulsed-laser deposition)

RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)



RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				JCPDS-ICDD No 42-136	
Bundy, F	1955	176	51	Nature (London)	HCAPLUS
Komatsu, S	2001	79	188	Appl Phys Lett	HCAPLUS
Komatsu, S	1999	103	3289	J Phys Chem B	HCAPLUS
Komatsu, S				Unpublished	
Mirkarimi, P	1997	21	47	Mater Sci Eng, R	
Mishima, O	1988	53	962	Appl Phys Lett	HCAPLUS
Mishima, O	1987	238	181	Science	HCAPLUS
Mishima, O	2000		495	Science and Technolo	
Pankove, J	1971			Optical Processes in	
Sokolowski, M	1979	46	136	J Cryst Growth	HCAPLUS
Spitzin, B	1981	52	219	J Cryst Growth	
Taniguchi, T	2002	41	L109	Jpn J Appl Phys, Par	HCAPLUS
Taylor, C	1994	65	1251	Appl Phys Lett	HCAPLUS
Ummels, R	1998	58	6795	Phys Rev B	HCAPLUS
Weissmantel, C	1980	72	19	Thin Solid Films	HCAPLUS
Wentorf, R	1957	26	956	J Chem Phys	HCAPLUS
Xu, Y	1991	44	7787	Phys Rev B	HCAPLUS
Yoshida, T	1996	5	501	Diamond Relat Mater	HCAPLUS

L109 ANSWER 3 OF 14 HCAPLUS
AN 2000:856946 HCAPLUS

DN 134:104416
TI Advances in the synthesis and characterization of **boron nitride**
AU Huang, Jianyu; Zhu, Yuntian T.
CS Division of Materials Science and Technology, Los Alamos National Laboratory, Los Alamos, NM, 87545, USA
SO Diffusion and Defect Data--Solid State Data, Pt. A: Defect and Diffusion Forum (**2000**), 186-187(Defects and Diffusion in Ceramics III), 1-32
CODEN: DDAFE7; ISSN: 1012-0386
PB Scitec Publications
DT Journal; General Review
LA English
AB A review, with 60 refs., of the progress in the expts. and understanding of high pressure and high temperature (HPHT) induced phase transformation in **boron nitride**. The HPHT induced phase transformation is significantly enhanced by refining the microstructure of the starting material, e.g., by ball-milling **hexagonal boron nitride** (**h-BN**) to a defective, nanocryst. or even amorphous state. For example, **cubic boron nitride** (**c-BN**) forms from nanocryst. or amorphous **BN** (a-**BN**) matrix at 900.degree.**C** and complete a-**BN** to **c-BN** phase transformation occurs at 1350.degree.**C** under 7.7 GPa. These temps. and pressures are significantly lower than required to transform coarse-grained crystalline **h-BN** to **c-BN**. High resolution TEM and EELS revealed that the **c-BN** phase nucleates directly from the **sp3** hybridized amorphous matrix, which is originally induced by ball milling and is therefore responsible for the lower HPHT requirements. This **c-BN** nucleation mechanism is completely different from the so-called diffusionless "puckering" mechanism that operates in the nucleation of **c-BN** from coarse-grained **h-BN** in HPHT expts., but very similar to one of the proposed mechanisms involved in the CVD of diamond and **c-BN**. HRTEM also shed new **light** on the phase transformation of slightly deformed coarse-grained **h-BN** under HPHT conditions. The interface structures among **h-**, w- and **c-BN** reveal that the phase transformation can proceed by different routes including **h** →w .fwdarw .**c**, **h** →g .fwdarw.**c**, **h** →w .fwdarw .**6H'** → **c**, **h** →w →2H' .fwdarw .**c**, **h** →am .fwdarw .**c** and **h** .fwdarw.**c**, where **h**, w, **c**, g, **6H'**, 2H' and am represent **h-BN**, w-**BN**, **c-BN**, g-**BN**, **6H'-BN**, 2H'-**BN** and a-**BN**, resp. Irresp. of these different transformation routes, all the phase transformations follow the same orientation relationships, i.e. [1120]h//[1120]w//[110]c and (1100)h//(1100)w//(111)c. The phase transformations also follow a general rule: at low temps., the formation of **c-BN** is always preceded by the formation of intermediate phases such as w-**BN**, 2H' and **6H'**, and the transformation is martensitic in nature; at higher temps., there is a direct **h-BN** to **c-BN** transformation, and the transformation is diffusional dominated. The transformation from w-**BN** to **c-BN** is achieved by introducing periodic stacking-faults (SFs) in w-**BN**. Based on the HRTEM images, three new BN **polytype** phases i.e., g-BN, 2H'-BN and **6H'**-BN, were proposed for the first time. HRTEM also revealed that ball-milling introduces significant defects such as SFs,

twins, Frank dislocations, delamination, rotating and shearing of the sp2 layers, and disordering in the **h-BN** lattice. These defects are found to promote the subsequent **hexagonal** to **cubic** transformation.

CC 57-0 (Ceramics)

ST **boron nitride** phase transformation mechanism temp pressure review

IT Structural phase transition
(pressure- and temperature-induced; high-pressure and high-temperature induced
phase transformation in **boron nitride**)

IT **10043-11-5, Boron nitride** (BN), processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(high-pressure and high-temperature induced phase transformation in **boron nitride**)

IT **10043-11-5, Boron nitride** (BN), processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(high-pressure and high-temperature induced phase transformation in **boron nitride**)

RN 10043-11-5 HCAPLUS

CN Boron nitride (BN) (CA INDEX NAME)

$B\equiv N$

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Amelinckx, S	1960	5	50	Phys Rev Lett	
Amelinckx, S	1966			Solid State Physics	
Berger, S	1988	57	285	Philo Mag Lett	HCAPLUS
Bohr, S	1995	4	714	Diamond Relat Mater	HCAPLUS
Bourgeois, L	1997	76	753	Philo Mag A	HCAPLUS
Bruley, J	1995	180	22	J Micros	HCAPLUS
Bundy, F	1963	38	1144	J Chem Phys	HCAPLUS
Choi, J	1993	76	2525	J Am Ceram Soc	HCAPLUS
Corrigan, F	1975	63	3812	J Chem Phys	HCAPLUS
Cottrell, A	1972		162	Dislocations and pla	
Cuomo, J	1991	58	466	Appl Phys Lett	HCAPLUS
De Vries, R	1972	13/14	88	J Cryst Growth	
Demazeau, G	1995	4	284	Diamond Relat Mater	HCAPLUS
Endo, T	1981	16	2227	J Mater Sci	HCAPLUS
Gladkaya, I	1986	117	241	J Less-Common Metals	HCAPLUS
Glaisher, R	1989	27	117	Ultramicroscopy	HCAPLUS
Green, J	1976	64	656	J Chem Phys	HCAPLUS
Heslop, R	1967			Inorganic Chemistry,	
Hess, J	1949	185	599	Trans AIME	
Hirano, S	1989	72	66	J Am Ceram Soc	HCAPLUS
Horiuchi, S	1998	78	1065	Phil Mag A	HCAPLUS
Huang, J	1996	44	1211	Acta Mater	HCAPLUS
Huang, J	1999	47	1801	Acta Mater	HCAPLUS
Huang, J	1999	303	130	Chem Phys Lett	HCAPLUS
Huang, J	2000	83	403	J Am Ceram Soc	HCAPLUS
Huang, J	1997		587	MRS Fall Meeting	
Huang, J	1999	79	217	Phil Mag Lett	HCAPLUS
Huang, J	1997			Unpublished result	

Huang, J	1998		327	the 5th NIRIM In	
Huang, J	1997			unpublished result	
Kelly, A	1970			Crystallography and	
Kelly, B	1981			Physics of Graphite	
Kester, D	1994	12	3074	J Vac Sci Technol A	HCAPLUS
Kobayashi, T	1979	70	5898	J Chem Phys	HCAPLUS
Kobayashi, T	1979	70	5898	J Chem Phys	HCAPLUS
Kurdyumov, A	1996	5	1225	Diamond Related Mate	
Lambrecht, W	1993	364	607	Nature (London)	HCAPLUS
Li, Z	1993	73	711	J Appl Phys	HCAPLUS
Luyten, W	1992	66	899	Philo Mag A	HCAPLUS
Mckenzie, D	1993	2	970	Diamond Relat Mater	HCAPLUS
Medlin, D	1994	50	7884	Phys Rev B	HCAPLUS
Mirkarimi, P	1997	R21	47	Mater Sci Eng	HCAPLUS
Mishima, O	1985	314	76	Nature	HCAPLUS
Muramatsu, W	1996	76	3846	Phys Rev Lett	
Orowan, E	1942	149	643	Nature (London)	
Pirouz, P	1993	51	189	Ultramicroscopy	HCAPLUS
Ramsdell, L	1947	32	64	Am Mineral	HCAPLUS
Singh, B	1995	152	143	J Cryst Growth	HCAPLUS
Solozhenko, V	1995	96	1	Solid State Comm	HCAPLUS
Solozhenko, V	1993	218	395	Thermochimica Acta	HCAPLUS
Sumiya, H	1983	18	1203	Mater Res Bull	HCAPLUS
Thomas, J	1963	84	4619	J Amer Chem Soc	
Turan, S	1995	150	227	Phys Stat Sol A	HCAPLUS
Verma, A	1966			Polymorphism and Pol	
Wakatsuki, M	1972	7	999	Mater Res Bull	HCAPLUS
Wentorf, R	1957	26	956	J Chem Phys	HCAPLUS
Wibbelt, M	1999	59	11739	Phys Rev B	HCAPLUS
Yamada-Takamura, Y	1999	59	10351	Phys Rev B	HCAPLUS
Yugo, S	1995	4	903	Diamond Relat Mater	HCAPLUS
Zhou, D	1995	72	163	Phil Mag Lett	HCAPLUS

L109 ANSWER 4 OF 14 HCAPLUS

AN **2000:221836** HCAPLUS
DN **132:301861**
TI Surface modification of **boron nitride** in **hydrogen plasma**
AU Khvostov, V. V.; Konyashin, I. Y.; Shouleshov, E. N.; Babaev, V. G.; Guseva, M. B.
CS Department of Physics, Moscow State University, Moscow, Russia
SO Applied Surface Science (**2000**), 157(3), 178-184
CODEN: ASUSEE; ISSN: 0169-4332
PB Elsevier Science B.V.
DT Journal
LA English
AB The state of the surface of poorly crystallized or amorphous (a-**BN**) and highly oriented **hexagonal** (**h-BN**) **B nitride** before and after treatment in a **H plasma** was studied by high-resolution Auger electron spectroscopy. Treatment of both modifications of **BN** in **H plasma** is found to lead to a partial transformation of sp2 bonds into **sp3** bonds on the surface. This probably is a result of terminating dangling bonds of sp2-hybridized **BN** by **H** atoms. The formation of chemical N-**H** bonds after treatment of **BN** in **H plasma** is found on the surface of both a-**BN** and **h-BN**, whereas in practice, B-**H** bonds appear to form only on the treated surface of **h-BN**.
CC 76-11 (Electric Phenomena)

Section cross-reference(s): 66

ST **hydrogen plasma** surface modification **boron nitride**

IT Bond
(boron-**hydrogen**; surface modification of **boron nitride** in **hydrogen plasma**)

IT Bond
(dangling; in surface modification of **boron nitride** in **hydrogen plasma**)

IT Bond
(**hydrogen-nitrogen**; surface modification of **boron nitride** in **hydrogen plasma**)

IT Bond
Density of surface states
Surface structure
(surface modification of **boron nitride** in **hydrogen plasma**)

IT **10043-11-5, Boron nitride**, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(surface modification of **boron nitride** in **hydrogen plasma**)

IT 1333-74-0, **Hydrogen**, processes
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(surface modification of **boron nitride** in **hydrogen plasma**)

IT **10043-11-5, Boron nitride**, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(surface modification of **boron nitride** in **hydrogen plasma**)

RN 10043-11-5 HCAPLUS

CN Boron nitride (BN) (CA INDEX NAME)

B≡N

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Badzian, A	1988	23	385	Mater Res Bull	HCAPLUS
Ching, Y	1991	44	7787	Phys Rev B	
Dementjev, A	1997	6	486	Diamond Relat Mater	HCAPLUS
Fomichev, V	1968	29	1015	J Phys Chem Solids	HCAPLUS
Guseva, M	1987	11		Surface investigatio	
Harrison, W	1980			Electronic Structure	
Hofsass, H	1998	66	153	Appl Phys A	
Kejun, L	1995	24	341	J Synth Cryst	
Loeffler, J	1997	6	608	Diamond Relat Mater	HCAPLUS
Loeffler, J	1996	87	170	Z Metallkd	HCAPLUS
McKenzie, M	1993	2	970	Diamond Relat Mater	
Robertson, J	1996	5	519	Diamond Relat Mater	HCAPLUS
Saitoh, H	1992	1	137	Diamond Relat Mater	HCAPLUS
Spear, K	1989	72	171	J Am Ceram Soc	HCAPLUS
Trehan, R	1990	8	4026	J Vac Sci Technol A	HCAPLUS
Zunger, A	1974	7	76	J Physi C	HCAPLUS

L109 ANSWER 5 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN 2000:130840 HCAPLUS
DN **132:268664**
TI In situ ellipsometry growth characterization of dual ion beam deposited **boron nitride** thin films
AU Franke, E.; Schubert, M.; Woollam, J. A.; Hecht, J.-D.; Wagner, G.; Neumann, H.; Bigl, F.
CS Department of Electrical Engineering, Center for Microelectronic and Optical Materials Research, University of Nebraska, Lincoln, NE, 68588-051, USA
SO Journal of Applied Physics (2000), 87(5), 2593-2599
CODEN: JAPIAU; ISSN: 0021-8979
PB American Institute of Physics
DT Journal
LA English
AB Pure **hexagonal, h**, as well as mixed-phase **cubic/hexagonal, c/h, boron nitride** thin films were deposited onto [001] silicon substrates using the dual ion beam deposition technique. The BN thin films were grown under UHV conditions at different substrate temps. and ion beam bombarding parameters. Thin-film growth was monitored using in situ spectroscopic ellipsometry at 44 wavelengths between 420 and 761 nm. The in-situ ellipsometric data were compared with two-layer growth model calcns. for the mixed-phase **c/h BN**, and with one-layer growth model calcns. for pure **h-BN** growth. In-situ data provide information on the optical properties of deposited **h-BN** and **c/h-BN** material, film thickness, and **BN** growth rates. A virtual interface approach is employed for the optical properties of the silicon substrate. The growth and nucleation of **c-BN** observed here confirms the cylindrical thermal spike model. The results for composition and thickness of the BN films were compared to those obtained from ex-situ IR transmission measurements and high-resolution transmission electron microscopy investigations.
CC 57-2 (Ceramics)
Section cross-reference(s): 73
ST dual ion beam deposited **boron nitride** film growth; **boron nitride** layered film growth ellipsometry optical property
IT Films
Films
(ceramic, **boron nitride**; growth and properties of dual ion beam-deposited **boron nitride** films)
IT Phase composition
(**cubic-hexagonal**; growth and properties of dual ion beam-deposited **boron nitride** films)
IT Ceramics
Ceramics
(films, **boron nitride**; growth and properties of dual ion beam-deposited **boron nitride** films)
IT Birefringence
Crystal growth kinetics
Interfacial structure
Optical absorption
Refractive index
(growth and properties of dual ion beam-deposited **boron nitride** films)
IT Vapor deposition process
(phys., dual-ion-beam; growth and properties of dual ion beam-deposited **boron nitride** films)

IT **10043-11-5, Boron nitride,** properties
RL: DEV (Device component use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(films; growth and properties of dual ion beam-deposited **boron nitride** films)
IT 7440-21-3, Silicon, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrate; growth and properties of dual ion beam-deposited **boron nitride** films)
IT **10043-11-5, Boron nitride,** properties
RL: DEV (Device component use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(films; growth and properties of dual ion beam-deposited **boron nitride** films)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)

$B\equiv N$

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Aspnes, D	1996	14	960	J Vac Sci Technol A	HCAPLUS
Aspnes, D	1983	27	985	Phys Rev B	HCAPLUS
Azzam, R	1984			Ellipsometry and Pol	
Barth, K	1997	92	96	Surf Coat Technol	HCAPLUS
Collins, R	1994	233	244	Thin Solid Films	
Davis, C	1992	226	30	Thin Solid Films	
Feldermann, H	1999	74	1552	Appl Phys Lett	HCAPLUS
Franke, E	1997	82	2906	J Appl Phys	HCAPLUS
Franke, E	1998	84	526	J Appl Phys	HCAPLUS
Franke, E	1998			PhD thesis, Universi	
Franke, E	1997	97	90	Surf Coat Technol	HCAPLUS
Friedmann, T	1994	76	3088	J Appl Phys	HCAPLUS
Geick, R	1966	146	543	Phys Rev	HCAPLUS
Gielisse, P	1967	155	1039	Phys Rev	HCAPLUS
Hahn, J	1996	5	1103	Diamond Relat Mater	HCAPLUS
Hofsass, H	1998	66	153	Appl Phys A: Solids	
Hofsass, H	1995	67	46	Appl Phys Lett	HCAPLUS
Hofsass, H	1997	55	13230	Phys Rev B	HCAPLUS
Ichiki, T	1994	75	1330	J Appl Phys	HCAPLUS
Jellison, G	1998	313-3	33	Thin Solid Films	
Kester, D	1994	12	3074	J Vac Sci Technol A	HCAPLUS
Kuhr, M	1995	74-75	806	Surf Coat Technol	HCAPLUS
McKenzie, D	1991	70	3007	J Appl Phys	HCAPLUS
Mirkarimi, P	1994	9	2925	J Mater Res	HCAPLUS
Mirkarimi, P	1997	R21	47	Mater Sci Eng, R	HCAPLUS
Palik, E	1998			Handbook of Optical	
Park, K	1997	70	315	Appl Phys Lett	HCAPLUS
Poerschke, R	1991			Semiconductor Group	
Reinke, S	1994	4	272	Diamond Relat Mater	
Robertson, J	1996	5	519	Diamond Relat Mater	HCAPLUS
Schubert, M	1997	70	1819	Appl Phys Lett	HCAPLUS
Sene, G	1996	5	530	Diamond Relat Mater	HCAPLUS
Stenzel, O	1996	158	281	Phys Status Solidi A	HCAPLUS
Weissmantel, C	1980	72	19	Thin Solid Films	HCAPLUS

Widany, J	1996	6	899	J Mater Chem	HCAPLUS
Woollam Co	1995			Guide to Using WVASE	
Yao, H	1991	70	3261	J Appl Phys	HCAPLUS
Zhou, W	1995	66	2490	Appl Phys Lett	HCAPLUS

L109 ANSWER 6 OF 14 HCAPLUS

AN **2000:1300** HCAPLUS

DN **132:80442**

TI Structure investigation of **BN** films grown by ion-beam-assisted deposition by means of polarized **IR** and Raman spectroscopy

AU El Mekki, M. Ben; Djouadi, M. A.; Guiot, E.; Mortet, V.; Pascallon, J.; Stambouli, V.; Bouchier, D.; Mestres, N.; Nouet, G.

CS Laboratoire Bourguignon des Materiaux et Procedes, ENSAM, Cluny, F-71250, Fr.

SO Surface and Coatings Technology (**1999**), 116-119, 93-99
CODEN: SCTEEJ; ISSN: 0257-8972

PB Elsevier Science S.A.

DT Journal

LA English

AB We present an optical investigation, by means of polarized **IR** spectroscopy and Raman scattering, of the microstructure and crystallinity of mixed films of **hexagonal** and **cubic boron nitride** (**h-BN** and **c-BN**, resp.). The films were deposited on an unheated silicon substrate by the ion-beam-assisted deposition method (IBAD) at low energy (400-500 eV). The deposition temperature, due to the ion bombardment, was in the range 200-250° at the end of the deposition process. Different film types were grown on a silicon substrate of dimensions 75 mm + 15 mm by changing the ion (**nitrogen** + **argon**) to atom (thermal boron) arrival ratio, ϕion/ϕB, in the range 0.69-3. Polarised **IR** reflectivity (PIRR) spectra were acquired at different positions on the BN film (different arrival ratios ϕion/ϕB) and show an important upwards shift of transverse optical (TO) and longitudinal optical (LO) phonons of the twofold degenerated mode E1u of the sp2 phase at the transition zone from sp2 to **sp3** phases. Several processes can shift the **IR** phonon peaks, including the degree of crystallinity, film thickness, film stoichiometry and intrinsic stress. The micro-Raman results and the full-width at half-maximum values of TO phonons of the E1u mode show that the BN film has a similar crystallinity in all regions. The effect of the film thickness was shown by using a microstructure-dependent model for the **IR** anisotropic effective dielec. function of thin films. In order to show the influence of the film stoichiometry in the E1u(TO) peak positions, a series of samples was deposited at 100% of **nitrogen** by changing the arrival flux ϕN/ϕB in the interval 0.75-2.5. It have been observed that, in this range of flux ratio, the E1u(TO) phonon shift is negligible in comparison with the shift observed in the PIRR measurements. This results suggest that this E1u(TO) phonon shift is due to the intrinsic stress. If we consider the findings of Friedmann et al. (1994) who suggested that nucleation of the **cubic** phase occurs as a result of extremely high stress, and those of Medlin et al. (1996) who showed a direct route to **c-BN** formation via a transformation of **h-BN** into rhombohedral **BN** (r-**BN**), we can conclude that, in our case, the shift observed is due to an intrinsic high-stress phase. Then, a structural modification of **h-BN** into r-**BN** phase might be involved as a precursor for nucleation of the **cubic** phase.

CC 49-5 (Industrial Inorganic Chemicals)
Section cross-reference(s): 57, 73, 76

ST **boron nitride** ion beam assisted deposition

IT Optical transmission
(**IR**; structure investigation of BN films grown by ion-beam-assisted deposition by polarized **IR** and Raman spectroscopy)
IT Vapor deposition process
(ion-beam-assisted; structure investigation of BN films grown by ion-beam-assisted deposition by polarized **IR** and Raman spectroscopy)
IT Crystallinity
IR reflection
Microstructure
Stress, mechanical
Structural phase transition
(structure investigation of BN films grown by ion-beam-assisted deposition by polarized **IR** and Raman spectroscopy)
IT **10043-11-5P, Boron nitride**, preparation
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(structure investigation of BN films grown by ion-beam-assisted deposition by polarized **IR** and Raman spectroscopy)
IT 7440-21-3, Silicon, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(substrate; structure investigation of BN films grown by ion-beam-assisted deposition by polarized **IR** and Raman spectroscopy)
IT **10043-11-5P, Boron nitride**, preparation
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(structure investigation of BN films grown by ion-beam-assisted deposition by polarized **IR** and Raman spectroscopy)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)

B≡N

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1994			Properties of Groups	
Ben El Mekki, M	1999			Diamond Relat Mater	
Bouchier, D	1994	89	369	Nucl Instrum Methods	HCAPLUS
Boudiombou, J	1997	46	96	Mater Sci Eng B	
Burat, O	1990	68	2780	J Appl Phys	HCAPLUS
Djouadi, M	1998	7	1657	Diamond Relat Mater	HCAPLUS
Geick, R	1966	146	543	Phys Rev	HCAPLUS
Gielisse, P	1967	155	1039	Phys Rev	HCAPLUS
Hofsass, H	1997	55	13230	Phys Rev B	HCAPLUS
Ilias, S	1998			J Appl Phys submitte	
Medlin, D	1996	79	3567	J Appl Phys	HCAPLUS
Mirkarimi, P	1998			Mater Sci Eng Rep in	
Nemanich, R	1981	23	6348	Phys Rev B	HCAPLUS
Plass, M	1996	69	46	J Appl Phys Lett	HCAPLUS
Polo, M	1997	6	1550	Diamond Relat Mater	HCAPLUS
Schubert, M	1997	56	13306	Phys Rev B	HCAPLUS
Stambouli, V	1990	43/44	137	Surf Coat Technol	
Werninghaus, T	1997	70	958	Appl Phys Lett	HCAPLUS

L109 ANSWER 7 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN 1999:229229 HCAPLUS

DN 130:359534
TI New Phase of **sp3**-Bonded **BN**: The **5H**
Polytype
AU **Komatsu, Shojiro; Okada, Katsuyuki**; Shimizu, Yoshiki;
Moriyoshi, Yusuke
CS National Institute for Research in Inorganic Materials, Tsukuba Ibaraki, 305-0044, Japan
SO Journal of Physical Chemistry B (**1999**), 103(17), 3289-3291
CODEN: JPCBFK; ISSN: 1089-5647
PB American Chemical Society
DT Journal
LA English
AB A new phase of **sp3**-bonded BN, i.e., **5H**
polytype, was found. The representative lattice parameters a and c are 2.528 and 10.407 Å, resp. The new BN phase was prepared by CVD assisted with 193 nm laser **irradiation** of the surface. Source **gases** were diborane and **NH3** diluted in **Ar** and H.
The substrate temperature was 850°.
CC 75-7 (Crystallography and Liquid Crystals)
ST laser assisted CVD **boron nitride 5H**
polytype; structure **boron nitride 5H**
polytype crystal
IT Vapor deposition process
(chemical, laser-assisted; laser-assisted CVD and crystal structure of **sp3**-bonded **boron nitride 5H**
polytype)
IT Crystal structure
Polytypism
(laser-assisted CVD and crystal structure of **sp3**-bonded
boron nitride 5H polytype)
IT **10043-11-5, Boron nitride** (BN), properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(laser-assisted CVD and crystal structure of **sp3**-bonded
boron nitride 5H polytype)
IT **10043-11-5, Boron nitride** (BN), properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(laser-assisted CVD and crystal structure of **sp3**-bonded
boron nitride 5H polytype)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)

$B \equiv N$

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Bundy, F	1963	38	1144	J Chem Phys	HCAPLUS
Komatsu, S	1997	12	1675	J Mater Res	HCAPLUS
Konyashin, I	1997	3	239	Chem Vapor Depositio	HCAPLUS
Moriyoshi, Y	1995	111/1	267	Key Eng Mater	
Narula, K	1995			Ceramic Precursor Te	
Soma, T	1974	9	755	Mater Res Bull	HCAPLUS
Verma, A	1966			Polymorphism and Pol	
Wentrof, R	1957	26	956	J Chem Phys	
Wentrof, R	1961	34	809	J Chem Phys	

Yarbrough, S |1997 |81 |7798 |J Appl Phys |

L109 ANSWER 8 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN **1997:109630** HCAPLUS
DN **126:204896**
TI Selective chemical etching of **hexagonal boron nitride** compared to **cubic boron nitride**
AU Harris, Stephen J.; Weiner, Anita M.; Doll, Gary L.; Meng, Wen-Jin
CS Physics and Physical Chemistry Department, General Motors RandD Center, Warren, MI, 48090-9055, USA
SO Journal of Materials Research (**1997**), 12(2), 412-415
CODEN: JMREEE; ISSN: 0884-2914
PB Materials Research Society
DT Journal
LA English
AB A BN film containing comparable amts. of sp2 and **sp3** phases was subjected to a **gas**-phase chemical etch in a hot-filament environment containing 1% CH4 in **H2**. After a partial etch, examination by FTIR shows that the sp2 was preferentially etched, leaving a larger **sp3** fraction than in the unetched film. The possibility that preferential etching could be used to increase the purity of **cubic BN** films is discussed.
CC 73-3 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 57, 76
ST **boron nitride** chem etching
IT **IR** spectra
(Fourier-transform; of selectively chemical etched **boron nitride**)
IT **IR** absorption
(by selectively chemical etched **boron nitride**)
IT Etching
(selective chemical etching of **hexagonal boron nitride** compared to **cubic boron nitride**)
IT **10043-11-5, Boron nitride,** properties
RL: PRP (Properties); RCT (Reactant); RACT (Reactant or reagent)
(**cubic**; selective chemical etching of **hexagonal boron nitride** compared to **cubic boron nitride**)
IT **10043-11-5, Boron nitride,** properties
RL: PRP (Properties); RCT (Reactant); RACT (Reactant or reagent)
(**cubic**; selective chemical etching of **hexagonal boron nitride** compared to **cubic boron nitride**)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)

L109 ANSWER 9 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN **1997:92788** HCAPLUS
DN **126:245439**
TI Sputter deposition of **boron nitride** using **neon -nitrogen** discharges
AU Heil, R. B.; Aita, C. R.

CS Department of Materials and Laboratory for Surface Studies, University of Wisconsin-Milwaukee, Milwaukee, WI, 53201, USA

SO Journal of Vacuum Science & Technology, A: Vacuum, Surfaces, and Films (**1997**), 15(1), 93-98
CODEN: JVTAD6; ISSN: 0734-2101
PB American Institute of Physics
DT Journal
LA English

AB **Boron nitride** films were grown by sputtering a **hexagonal boron nitride** (**BN**) pressed powder target in **Ne/N2** discharges at two levels of substrate bias. Optical emission spectrometry was used to monitor the **N2**+ ion population in the discharge. Post-deposition, information about B-N bonding in the films was obtained using near **UV** -visible spectrophotometry to determine optical absorption edge characteristics, and **IR** transmission spectrometry to determine vibrational frequencies of B-N groups. The results are compared to films grown in **Ar/N2** discharges at the same excitation conditions. The goal was to examine the effect of an enhanced **N2** + ion population (characteristic of **Ne/N2** discharges) on B-N bonding. **N2**+ enhancement alone, without substrate bias, cannot produce **sp3** bonding. Biasing results in **sp3** -bonded BN with wurtzite short-range order. Without exception, films on grounded substrates have sp2 bonding. A simple model is proposed to relate optical edge disorder in sp2-bonded BN (associated with B-N bond length randomness) to **N2**+ adsorption at the growth interface.

CC 76-11 (Electric Phenomena)
Section cross-reference(s): 75

ST **boron nitride** sputter deposition **gas** discharge

IT Bond length
Interfacial structure
Optical absorption
(optical absorption of **boron nitride** from N-**Ne** discharge sputter deposition)

IT Electric discharge
Sputtering
(sputter deposition of **boron nitride** using **neon-nitrogen** discharges)

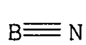
IT **10043-11-5P, Boron nitride** (BN), properties
RL: PNU (Preparation, unclassified); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(sputter deposition of **boron nitride** using **neon-nitrogen** discharges)

IT 7440-01-9, **Neon**, reactions 17778-88-0, Atomic **nitrogen**, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(sputter deposition of **boron nitride** using **neon-nitrogen** discharges)

IT **10043-11-5P, Boron nitride** (BN), properties
RL: PNU (Preparation, unclassified); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(sputter deposition of **boron nitride** using **neon-nitrogen** discharges)

RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)

L109 ANSWER 10 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN **1995:783863** HCAPLUS
DN **123:297889**
TI Surface characterization of **hexagonal** and **cubic** **boron nitride** films synthesized using IBAD
AU Sene, G.; Bouchier, D.; Ilias, S.; Djouadi, M. A.; Stambouli, V.; Moeller, P.; Hug, G.; Reinke, S.
CS Lab. Microstructures, ONERA, Chatillon, F-92322, Fr.
SO Proceedings - Electrochemical Society (**1995**), 95-4(Proceedings of the International Symposium on Diamond Materials, 1995), 377-82
CODEN: PESODO; ISSN: 0161-6374
PB Electrochemical Society
DT Journal
LA English
AB **C-BN** and **h-BN** films were
synthesized using ion beam assisted deposition (IBAD). TtEELS and REELS
analyses performed at various primary energies enabled us to emphasize
analyses performed at various primary energies enabled us to emphasize the
differences between **sp3** and sp2 bonded films. Consequences on
the **c-BN** growth modeling are discussed based on the
following result that polycryst. **cubic BN** films
exhibit a superficial zone with a sp2 hybridization. The thickness of
this superficial zone is increased by a post-deposition ion beam
bombardment at an energy value higher than that used for deposition. The
"subplantation" models fit well with this behavior. However, a possible
surface reconstruction cannot be excluded to explain our REELS results.
CC 66-3 (Surface Chemistry and Colloids)
ST **boron nitride** surface structure electron configuration
IT Electron configuration and Electron density
Surface structure
(surface characterization of **hexagonal** and **cubic** **boron nitride** films synthesized using ion beam assisted deposition)
IT **10043-11-5, Boron nitride,** properties
RL: PRP (Properties)
(surface characterization of **hexagonal** and **cubic** **boron nitride** films synthesized using ion beam assisted deposition)
IT **10043-11-5, Boron nitride,** properties
RL: PRP (Properties)
(surface characterization of **hexagonal** and **cubic** **boron nitride** films synthesized using ion beam assisted deposition)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)



L109 ANSWER 11 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN **1994:468369** HCAPLUS
DN **121:68369**
TI **Infrared** spectroscopic investigations on **h-BN** and mixed **h/c-BN** thin films
AU Jaeger, S.; Bewilogua, K.; Klages, C. P.
CS Fraunhofer-Institut fuer Schicht- und Oberflaechentechnik (FhG-IST),

Vogt-Koelln-Str. 30, Hamburg, D-22527, Germany
SO Thin Solid Films (**1994**), 245(1-2), 50-4
CODEN: THSFAP; ISSN: 0040-6090
DT Journal
LA English
AB The integrated absorptions of the **IR** active bands at .apprx.1390, 1080, and 780 cm-1 were used to determine the content of **hexagonal B nitride h-BN** (sp2 bonding state) and **cubic B nitride c-BN** (**sp3** bonding state) modifications in r.f. sputtered stoichiometric **BN** films. For the calcn. of oscillator number densities in **hexagonal B nitride** (**h-BN**) from integrated absorptions, calibration consts. Ah can be used, which are 1.7 + 1019cm-2 for the B-N stretching vibration at 1390 cm-1 and 9.1 + 1019 cm-2 for the B-N-B bending vibration at 780 cm-1, resp. The ratio of the volume fractions fc/fh of mixed **h/c-BN** films can be determined from the ratios of the absorption coeffs. α(1080 cm-1)/α(1390 cm-1) and α(1080 cm-1)/α(780 cm-1) multiplied by factors of 0.6 and 0.19, resp.
CC 73-3 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
ST **IR** spectra **boron nitride hexagonal cubic**
IT **Infrared** spectra
(of **boron nitride hexagonal** and mixed **hexagonal/cubic** thin films)
IT Absorptivity
(of **boron nitride hexagonal** and mixed **hexagonal/cubic** thin films in **IR** region)
IT **10043-11-5, Boron nitride**, properties
RL: PRP (Properties)
(**IR** spectra of **hexagonal** and mixed **hexagonal/cubic** thin films of)
IT **10043-11-5, Boron nitride**, properties
RL: PRP (Properties)
(**IR** spectra of **hexagonal** and mixed **hexagonal/cubic** thin films of)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)

B≡N

L109 ANSWER 12 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN 1991:497752 HCAPLUS
DN **115:97752**
TI Microstructure of pressureless sintered **h-boron nitride**
AU Miyazaki, Yuji; Harada, Hiroshi; Sakamaki, Shozo; Hagio, Tsuyoshi
CS Denki Kagaku Kogyo Co., Ltd., Omuta, 836, Japan
SO Nippon Seramikkusu Kyokai Gakujutsu Ronbunshi (1991), 99(July), 582-5
CODEN: NSKRE2; ISSN: 0914-5400
DT Journal
LA Japanese
AB The microstructure of pressureless-sintered bodies of **hexagonal (h)-BN** prepared from a powder activated by mechanochem. treatments was examined by SEM and TEM. The BN compacts showed a

3-dimensionally bonded network structure consisting of platey BN microcrystals. The interconnected regions between 2 particles are continuous in microstructure without any orientational relation between them. The interconnected network, which would improve properties of BN bodies, was characterized for the pressureless sintered bodies.

CC 57-2 (Ceramics)

ST microstructure **boron nitride** pressureless sintering

IT Ceramic materials and wares
(**boron nitride**, microstructure of pressureless-sintered **hexagonal**)

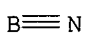
IT Sintering
(pressureless, of **boron nitride**, microstructure in relation to)

IT **10043-11-5, Boron nitride**, uses and miscellaneous
RL: USES (Uses)
(ceramics, microstructure of pressureless-sintered **hexagonal**)

IT **10043-11-5, Boron nitride**, uses and miscellaneous
RL: USES (Uses)
(ceramics, microstructure of pressureless-sintered **hexagonal**)

RN 10043-11-5 HCAPLUS

CN Boron nitride (BN) (CA INDEX NAME)



L109 ANSWER 13 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN

AN **1990:576766** HCAPLUS

DN **113:176766**

TI Low-energy Auger transitions of **hexagonal** and **cubic boron nitride** (**h-BN** and **c-BN**): an example of the influence of crystallographic structure on the Auger decay

AU Hanke, G.; Kramer, M.; Mueller, K.

CS Dep. Dev. Constr., FAG Kugelfischer K.G.a.A., Schweinfurt, D-8720, Germany

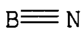
SO Materials Science Forum (**1990**), 54-55(Synth. Prop. Boron Nitride), 207-27
CODEN: MSFOEP; ISSN: 0255-5476

DT Journal

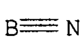
LA English

AB Auger spectra obtained from **cubic** and **hexagonal BN** are presented and compared with those observed for B, B4C, and B2O3. Characteristic changes in these low-energy spectra depend on the addnl. decay channels supplied by the bonding partners for the recombination of the B core hole. Supported by SXS data, the main features can be understood in terms of a selfconvolution model of the p-like degree of sensitization (DOS). Deviations from this model can be discussed by partial localization in the bonding resulting in different final states. Especially the existance of an extra peak at the low-energy side of the B-KVV transitions of the nitrides and the oxide can be explained by this model. Based on EELS-measurements a high-energy peak in the Auger multiplet of **h-BN** may be the direct **nonradiative** recombination of a core exciton. The comparison of the new Auger data for **c-BN** with those observed from **h-BN** reveals differences which are not expected by regarding their quite similar local DOS from SXS spectra. The differences are attributed to the different **sp3** and sp2 hybridization

leading to distinct localizations.
CC 57-2 (Ceramics)
ST Auger spectra **boron nitride**
IT Electron emission
(Auger, of **boron nitride**, crystallog. structure
effect on)
IT **10043-11-5, Boron nitride** (**BN**),
properties
RL: PRP (Properties)
(Auger spectra of **cubic** and **hexagonal**)
IT **10043-11-5, Boron nitride** (**BN**),
properties
RL: PRP (Properties)
(Auger spectra of **cubic** and **hexagonal**)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)



L109 ANSWER 14 OF 14 HCAPLUS COPYRIGHT 2007 ACS on STN
AN 1980:200320 HCAPLUS
DN **92:200320**
TI Formation and shape of fibrous **h boron nitride**
AU Sato, Tadao; Sekikawa, Yoshizo; Ishii, Toshihiko
CS Natl. Inst. Res. Inorg. Mater., Tokyo, Japan
SO Koen Yoshishu - Jinko Kobutsu Toronkai, 24th (1979), 45-6 Publisher: Jinko
Kobutsu Toronkai Jimu Senta, Nagoya, Japan.
CODEN: 42NKAR
DT Conference
LA Japanese
AB Powdered **hexagonal BN** was heated in a graphite crucible
at 2100° under **N_2** for 2 **h** to form white fibers
containing mainly B and N. There were 4 shapes of fibrous **hexagonal**
BN: jellyfish shape, bone shape, field-horsetail shape, and bulb
shape.
CC 49-5 (Industrial Inorganic Chemicals)
ST **boron nitride hexagonal** fiber
IT Synthetic fibers
RL: USES (Uses)
(**boron nitride**, shape of)
IT **10043-11-5P**, uses and miscellaneous
RL: PREP (Preparation)
(preparation and shape of fibers of)
IT **10043-11-5P**, uses and miscellaneous
RL: PREP (Preparation)
(preparation and shape of fibers of)
RN 10043-11-5 HCAPLUS
CN Boron nitride (BN) (CA INDEX NAME)



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FILE LAST UPDATED:                        24 JUL 2007   &lt;20070724/UP&gt;
MOST RECENT THOMSON SCIENTIFIC UPDATE:     200747       &lt;200747/DW&gt;
DERWENT WORLD PATENTS INDEX SUBSCRIBER FILE, COVERS 1963 TO DATE

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    20061231/UPIC and 20060601/UPIC. <<<

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    PLEASE SEE
http://www.stn-international.de/stndatabases/details/dwpi_r.html <<<
'BI ABEX' IS DEFAULT SEARCH FIELD FOR 'WPIX' FILE

=> d bib ab tech abex tot

L124 ANSWER 1 OF 6  WPIX COPYRIGHT 2007      THE THOMSON CORP on STN
AN    2002-158148 [21]    WPIX
DNC   C2002-049429 [21]
TI    Manufacture of boron nitride nano tube with
      SP3 bonding, involves irradiating carbon dioxide laser on
      substance containing carbon and boron and forming boron
      nitride on surface of substance using supercritical nitrogen
DC    L02; L03
IN    KURASHIMA K; YUSA H
PA    (DOKU-N) DOKURITSU GYOSEI HOJIN BUSSHITSU ZAIRYO
CYC   1
PIA   JP 2001270707    A   20011002 (200221)* JA   4[4]              <--
      JP 3448638       B2 20030922 (200363)  JA   4
ADT   JP 2001270707 A JP 2000-87835 20000328; JP 3448638 B2 JP
      2000-87835 20000328
FDT   JP 3448638 B2 Previous Publ JP 2001270707 A
PRAI  JP 2000-87835 20000328
AB    JP 2001270707 A   UPAB: 20050525
       NOVELTY - A substance containing carbon and boron is irradiated by a
      carbon dioxide laser at a high pressure of 5 GPa or more using a diamond
      Anvil cell apparatus at 1000degreesC or more. A boron
      nitride component is formed on the surface of the raw material
      substance using a supercritical nitrogen fluid, and boron
      nitride nano tube with SP3 bonding is obtained.
             DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for
      boron nitride nano tube containing SP3 bonding
      close to the center of shell.
             USE - For manufacture of boron nitride nano
      tube with SP3 bonding used for electronic device.
             ADVANTAGE - Boron nitride nano tube with
      SP3 bonding and high rigidity is obtained.
             DESCRIPTION OF DRAWINGS - The figure shows schematic diagram of
      boron nitride nano tube manufacturing apparatus.
      (Drawing includes non-English language text).
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L124 ANSWER 2 OF 6 WPIX COPYRIGHT 2007 THE THOMSON CORP on STN
AN **1999-228510** [19] WPIX
DNC C1999-067163 [19]
DNN N1999-169071 [19]
TI Ion-implantation converts **hexagonal boron nitride** to cubic form - by implanting nitrogen ions into a thin film on a substrate at low temperatures
DC L03; V05; X14
IN DOLL G L; MANTESE J V
PA (GENK-C) GENERAL MOTORS CORP
CYC 1
PIA US 5885666 A 19990323 (199919)* EN 6[3] <--
ADT US 5885666 A **US 1997-851801 19970506**
PRAI **US 1997-851801 19970506**
AB US 5885666 A UPAB: 20050521
NOVELTY - Nitrogen ions are implanted into about one-half the depth of a film no more than 100 nm thick containing sp2-bonded boron and nitrogen atoms to convert many of these to **sp3** bonding. DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for a method comprising implanting nitrogen ions at 180 keV, 2E17 cm-2 and 50 -100 μA.

USE - For converting poorly crystallised **hexagonal**-like BN films with sp2 bonding into amorphous cubic-like material with **sp3** bonding for protective, wear-resistant coatings, abrasives and machining inserts.

ADVANTAGE - The use of very high temperatures and pressures in the conversion is avoided and temperatures of 150 °C or less can be used. DESCRIPTION OF DRAWING(S) - Near-edge x-ray absorption fine structure spectra are shown for the BN species.

L124 ANSWER 3 OF 6 WPIX COPYRIGHT 2007 THE THOMSON CORP on STN
AN **1998-125961** [12] WPIX
DNC C1998-041438 [12]
DNN N1998-100434 [12]
TI Preparation of **sp3** bonded **boron nitride** - by introducing sources of boron and nitrogen into reaction vessel and growing **sp3** bonded **boron nitride**
DC E36; L02; L03; P54; U11
IN MATSUMOTO S
PA (KAGG-C) KAGAKU GIJUTSUCHO MUKIZAISHITSU
CYC 1
PIA JP 10007409 A 19980113 (199812)* JA 4[1] <--
JP 2920203 B2 19990719 (199934) JA 4 <--
ADT JP 10007409 A **JP 1996-184097 19960625**; JP 2920203 B2 **JP 1996-184097 19960625**
FDT JP 2920203 B2 Previous Publ JP 10007409 A
PRAI **JP 1996-184097 19960625**
AB JP 10007409 A UPAB: 20050520
Preparation of **sp3** bond **boron nitride** in which sources of boron and nitrogen in a gaseous state are introduced into a reaction vessel and **sp3** bond **boron nitride** is grown so that at least one of the substrate surface, growth surface of the substrate, and growth space is irradiated with ir and **boron nitride** is grown. Also claimed is preparation of semiconductor type **sp3** bond **boron nitride**, in which at least one source of groups II, IV, and VI elements is introduced as an additive.

USE - The **sp3** bond **boron nitride** can be used as cutting materials, abrasives, optoelectronic materials of wide band gap semiconductors, ultraviolet emitting materials, electroluminescent materials, and high-temperature semiconductor materials.

ADVANTAGE - The **sp3** bond **boron nitride** can be synthesised easily in a gaseous state.

L124 ANSWER 4 OF 6 WPIX COPYRIGHT 2007 THE THOMSON CORP on STN
AN **1998-114667** [11] WPIX
DNC C1998-037844 [11]
TI Preparing four coordinate **boron nitride** material by photo-excitation - using sintered products and monocrystals of **boron nitride**, bonded in specific manner
DC E33; L02; L03; U11; U12
IN ERA A
PA (HELI-N) HELIOS KOKAGAKU KENKYUSHO YG
CYC 1
PIA JP 10001304 A 19980106 (199811)* JA 4[2] <--
ADT JP 10001304 A **JP 1996-191318 19960617**
PRAI **JP 1996-191318 19960617**
AB JP 10001304 A UPAB: 20060114
In the preparation of four coordinate **boron nitride** material by photoexcitation, one of powders, sintered prods. and monocrystals of BN which is bonded with the sp2 hybrid orbital, e.g. **hexagonal** BN (hBN), rhomboid BN (rBN), pyrolytic BN (pBN), turbulent BN (tBN), and amorphous BN (aBN), all referred to as the sp2 phase hereafter, is used as a raw material and irradiated heavily with ultrashort pulse laser beams which resonate with oscillation mode vertically displacing w.r.t. the face containing the bond consisting of the sp2 hybrid orbital to produce four coordinate BN (referred to as the **sp3** phase hereafter) which is bonded with the **sp3** hybrid orbital, e.g. cubic BN (cBN) and wurtzite BN (wBN).

USE - The BN can be used in light emitting diode and electroluminescent materials, semiconductor device materials for detecting neutrons, semiconductor device materials, and ultrahard materials for cutting and grinding.

ADVANTAGE - Four coordinate **boron nitride** such as cBN and wBN can be produced without high-pressure and high-temperature conditions.

L124 ANSWER 5 OF 6 WPIX COPYRIGHT 2007 THE THOMSON CORP on STN
AN **1995-130257** [17] WPIX
DNC C1995-060229 [17]
DNN N1995-102351 [17]
TI Solid state conversion of **hexagonal** to cubic-like **boron nitride** - by annealing **hexagonal** material in a gaseous atmos.
DC E36; L03; U11
IN DOLL G L; HEREMANS J P
PA (GENK-C) GENERAL MOTORS CORP
CYC 1
PIA US 5398639 A 19950321 (199517)* EN 5[1] <--
ADT US 5398639 A **US 1993-150312 19931112**
PRAI **US 1993-150312 19931112**
AB US 5398639 A UPAB: 20050511
A method of solid state conversion of **hexagonal** to cubic-like BN comprises providing a non-crystalline film comprising **hexagonal** BN film on a substrate, annealing the film in a gaseous atmos. ≤1000°C, ≤2GPa pressure, and without a catalyst so that a portion of the **hexagonal** BN in the film is converted to cubic-like BN.

USE - Solid state conversion of **hexagonal** BN to cubic-like BN, for use in high power electronic and optoelectronic devices.

ADVANTAGE - Conversion at relatively low pressure, crystalline cubic

BN formed, 90 weight% **sp3** bonded material.

L124 ANSWER 6 OF 6 WPIX COPYRIGHT 2007 THE THOMSON CORP on STN
AN **1995-085177** [12] WPIX
DNC C1995-038597 [12]
TI Glass material holding and transporting member - have a thin film of **h-boron nitride** and amorphous **boron nitride** attached to a surface whilst in contact with the glass
DC L01
IN KAWAHO T
PA (OLYU-C) OLYMPUS OPTICAL CO LTD
CYC 1
PIA JP 07010560 A 19950113 (199512)* JA 7
JP 3049135 B2 20000605 (200032) JA 5
ADT JP 07010560 A JP 1991-321197 19911108; JP 3049135 B2 JP 1991-321197 19911108
FDT JP 3049135 B2 Previous Publ JP 07010560 A
PRAI JP 1991-321197 19911108
AB JP 07010560 A UPAB: 20050511
A thin film of h-BN, amorphous BN or the mixture of these is attached to a surface to be kept in contact with glass, or a base or hard metal graphite, cyalone, AIN, quartz, SiC, Si3N4 or BN.
ADVANTAGE - Deformation of transporting member can be prevented.

=> => d bib ab tech abex

L126 ANSWER 1 OF 1 WPIX COPYRIGHT 2007 THE THOMSON CORP on STN
AN **2004-108798** [11] WPIX
DNC C2004-044533 [11]
DNN N2004-086442 [11]
TI UV-emitting **sp3**-bonded **boron nitride** has a **hexagonal 5H**-type or **6H**-type polygonal structure, used as electronic material of e.g. light-emitting diode, as electron-emitting material and as material for coating surface of cutting tool
DC E36; L03; V08
IN KOMATSU S; MORIYOSHI Y; OKADA K
PA (DOKU-N) DOKURITSU GYOSEI HOJIN BUSSHITSU ZAIRYO; (NAMA-N) NAT INST MATERIALS SCI
CYC 29
PIA WO 2004005186 A1 20040115 (200411)* JA 30[6]
JP 2004035301 A 20040205 (200411) JA 15
JP 3598381 B2 20041208 (200481) JA 13
EP 1518824 A1 20050330 (200522) EN
US 20060163527 A1 20060727 (200650) EN
ADT WO 2004005186 A1 WO 2003-JP8370 20030701; JP 2004035301 A **JP 2002-192863 20020702**; JP 3598381 B2 **JP 2002-192863 20020702** ; EP 1518824 A1 EP 2003-738617 20030701; EP 1518824 A1 WO 2003-JP8370 20030701; US 20060163527 A1 WO 2003-JP8370 20030701; US 20060163527 A1 US 2004-518644 20041220
FDT JP 3598381 B2 Previous Publ JP 2004035301 A; EP 1518824 A1 Based on WO 2004005186 A
PRAI **JP 2002-192863 20020702**
AB WO 2004005186 A1 UPAB: 20060121
NOVELTY - An **sp3**-bonded **boron nitride** is represented by BN, has a **hexagonal 5H**-type or **6H**-type polygonal structure and has the ability to emit light in the UV region.
DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for (1)

the manufacture of the **sp3**-bonded **boron nitride** by introducing a reaction mixed gas containing boron and nitron diluted with a diluent gas into a reaction container, irradiating UV light on the substrate surface arranged in the container, the growth surface on the substrate, or near growth area, and forming **sp3** -bonded on the substrate by a vapor phase reaction; and (2) a functional material formed which contains the **sp3**-bonded **boron nitride**.

USE - The **boron nitride** is used e.g. as an electronic material of e.g. a light-emitting diode, as an electron-emitting material and as a material for coating the surface of a cutting tool.

ADVANTAGE - The **boron nitride** emits light of a sharp peak near 225 nm and is a material which can put a solid UV laser to a practical use.

DESCRIPTION OF DRAWINGS - Figure 1 shows the reaction container and its synthesis state. (Drawing contains non-English language text).

TECH

INORGANIC CHEMISTRY - Preferred Method: The diluent gas is a rare gas, hydrogen or nitrogen or their mixture. The amount of the reaction gas to the diluent gas is 100:0.0001-100 vol%. The UV light has a wavelength of 190-400nm. The UV light laser is a pulse laser.

ABEX EXAMPLE - A diborane flow (5 sccm) and an ammonia flow (10 sccm) are introduced into a diluent gas flow mixture of argon flow amount 3 SLM and hydrogen flow amount 100 sccm. On a silicon substrate retained at 850degreesC by heating under an atmosphere of 20Torr, excimer laser UV light is irradiated. A material is obtained after 90 minutes. The crystal system by X-ray diffraction is **hexagonal** and **5H** polygonal structure with **sp3** bonding. The lattice constants are a = 2.53Angstrom, and c = 10.40Angstrom.

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=> d his

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L2            1 S E3
                E KOMATSU S/AU
L3          126 S E3,E4
                E KOMATSU SHO/AU
L4           70 S E8
                E KOMATSU NAME/AU
L5           30 S E4
                E OKADA/AU
L6            4 S E3
                E OKADA K/AU
L7          841 S E3
L8           62 S E46
                E OKADA NAME/AU
L9           99 S E4
                E MORIYOSHI/AU
                E MORIYOSHI Y/AU
L10         273 S E3,E10-E12
L11           1 S E14
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                E SHO/AU
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                  E YUSUKE/AU
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                  E NATIONAL INSTITUTE FOR/PA,CS
                  E NATIONAL INSTITUTE FOR M/PA,CS
L13            45 S E19-E48
L14           316 S E99-E108
L15           282 S E109-E142
                  E NAT INST/PA,CS
                  E NAT INST MAT/PA,CS
                  E N INST MAT/PA,CS
                  E NAT INS MAT/PA,CS
                  E NAT INST MAT/CO
                  E NATION INST/CO
L16             3 S E9
                  E NATIONAL INST/CO
                  E NATION INST MAT/CO
L17             3 S E7
L18             1 S L1 AND L2-L17
                  SEL RN

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L20             1 S L19 AND BN/MF
                  E BN/MF
L21            11 S E3
L22            11 S L20,L21
L23             2 S L19 NOT L22

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L24         24313 S L22
L25         24772 S BORON NITRIDE
L26           537 S BORON MONONITRIDE
L27             4 S BORONNITRIDE
L28         26241 S L24-L27
L29           190 S L28 AND SP3
L30             1 S L28 AND SP 3
L31           191 S L29,L30
L32           137 S L31 AND PY<=2002 NOT P/DT
L33             7 S L31 AND (PD<=20020702 OR PRD<=20020702 OR AD<=20020702) AND P
L34           144 S L32,L33
L35             2 S L34 AND (5H OR 6H)(L)HEXAGON?
L36            50 S L34 AND HEXAGON?
L37             3 S L34 AND POLYTYP?
L38             3 S L34 AND LIGHT(L)(EMIT? OR EMIS?)
L39             8 S L34 AND UV
L40             8 S L34 AND (ULTRAVIOL? OR ULTRA VIOL?)
L41            36 S L34 AND IR
L42             9 S L34 AND IRRADIAT?
L43             7 S L34 AND LIGHT
                  E UV/CT
L44          7784 S E20-E22 OR E20+OLDNT OR E56-E58 OR E56+OLD,NT OR E60+OLD,NT
L45             1 S E78
L46          7883 S E81+OLD,NT OR E83+OLD,NT OR E84 OR E87+OLD,NT OR E88-E90
L47           394 S E136+OLD,NT OR E136-E138
L48          4414 S E152+OLD,NT OR E153
                  E E78+ALL
L49             1 S L34 AND L44-L48
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                E LASERS/CT
L50      145812 S E3+OLD,NT
L51        2164 S E50,E51
L52           1 S L34 AND L50,L51
                E ELECTROLUMINESC/CT
L53       58513 S E4 OR E8+OLD,NT
                E E4+ALL
L54        8790 S E2
                E E2+ALL
L55      269728 S E7+OLD,NT OR E8 OR E9
                E E14+ALL
L56       58339 S E18+OLD
L57           3 S L34 AND L50-L56
L58          82 S L35-L43,L49,L52,L57
L59           3 S L1-L18 AND L34
L60          82 S L58,L59
L61           3 S L34 AND (5H OR 6H)(L)POLYTYP?
L62          82 S L60,L61
L63        7614 S L25/TI
L64          14 S L26/TI
L65           0 S L27/TI
L66        2574 S BN/TI
L67          70 S L62 AND L63-L66
L68          12 S L62 NOT L67
L69          14 S L67 AND (CBN OR BCN OR B C N OR C B N)
                SEL AN 7 9 11 L69
L70           3 S L69 AND E1-E6
L71          56 S L67 NOT L69
L72          34 S L71 AND CUBIC
L73          22 S L72 AND (IR OR ?RADIAT? OR INFRARED?)
L74          15 S L71 AND GAS?
L75          35 S L59,L70,L73,L74
L76          32 S L71,L72 AND L75
L77          35 S L75,L76
L78          24 S L71,L72 NOT L77
L79          59 S L77,L78
L80          37 S L79 AND (C OR CUBIC)(S)(BN OR BORON NITRIDE OR BORON MONONITR
L81          38 S L79 AND HEXAG?
L82          51 S L80,L81
L83           4 S L79 AND (5H OR 6H)
L84           4 S L34 AND (5H OR 6H)
L85           4 S L83,L84
L86           4 S L59,L85 AND L1-L18,L24-L85
L87          50 S L34 AND HEXAG?
L88           3 S L34 AND POLYTYP?
L89           4 S L86,L88
L90          48 S L87 NOT L89
                SEL DN AN 10 24 25 33 38 44 L90
L91           6 S L90 AND E7-E24
L92          10 S L89,L91
L93         944 S H BN
L94           6 S H()(L25 OR L26 OR L27)
                SEL DN 4-6
L95           3 S L94 AND E25-E27
L96          13 S L92,L95
L97          31 S L93 AND (SP3 OR SP 3)
L98          22 S L97 AND PY<=2002 NOT P/DT
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L99           2 S L98 AND E28-E33
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L101          12 S L100 AND (H OR HEXAG? OR C OR CUBIC)(S)(BN OR BORON NITRIDE O
L102           2 S L100 NOT L101
L103          14 S L101,L102
L104           3 S L103 AND B NITRIDE
L105          14 S L103,L104
L106           5 S L105 AND GAS?
L107           2 S L105 AND PLASMA

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L108           8 S L105 AND (H2 OR HYDROGEN OR HE OR HELIUM OR NE OR NEON OR AR
L109          14 S L105-L108

     FILE 'HCAPLUS' ENTERED AT 16:28:19 ON 25 JUL 2007

     FILE 'WPIX' ENTERED AT 16:28:36 ON 25 JUL 2007
L110       12010 S L25 OR L26 OR L27
                 E BORON NITRIDE/CN
L111           1 S E3
L112        5394 S R01893/DCN OR 1893/DRN
L113        1098 S B()(NITRIDE OR MONONITRIDE OR MONO NITRIDE)
L114        1628 S E31-Q03/MC
L115       14292 S L110,L112-L114
L116          20 S L115 AND (SP3 OR SP 3)
L117          13 S L116 AND (PD<=20020702 OR PRD<=20020702 OR AD<=20020702)
L118          11 S L115 AND (5H OR 6H)
L119        1121 S L115 AND HEXAG?
L120           7 S L118 AND (PD<=20020702 OR PRD<=20020702 OR AD<=20020702)
L121           6 S H()(BORON NITRIDE OR BORON MONONITRIDE OR BORON MONO NITRIDE
L122          25 S L117,L120,L121
L123          25 S L122 AND L110-L122
                 SEL AN 12 17 19 20-22
L124           6 S L123 AND E1-E6

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L125          19 S L123 NOT L124
                 SEL AN 4
L126           1 S L125 AND E7

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